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Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
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Method for recording information on a multi layer record carrier

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Method for recording information on a multi layer record carrier

The invention relates to a method of recording information on a multi layer record carrier. The invention relates especially to a method of recording information on a dual layer recordable DVD disc, such that this disc can be played in any DVD-ROM player.

After recording information on a recordable DVD record carrier, special actions need to be taken to make the record carrier compatible with existing playback devices. When a recordable DVD record carrier has to be made DVD-ROM compliant, such that the recordable DVD record carrier can be played back in any DVD-ROM player, any unwritten zones need to be filled with dummy data according to the DVD-ROM specification. This needs to be done when closing a session and/or finalizing a disc.

The total available size for storing data on a dual layer OTP-type (Opposite Track Path) DVD record carrier (recordable, rewritable, as well as read-only discs) is dependent on the location of the middle zone. When information of a previously unknown size has to be written on a dual layer recordable DVD record carrier using a sequential method for writing, the location of the middle zone should preferably be placed at the maximum allowed position, which results in a maximum storage space. A downside of placing the middle zone at the maximum allowed position is the amount of time the filling with dummy data may take.

Figure 1 shows an example of a worst-case situation where a complete data zone in a layer has to be filled with dummy data. When the complete available data zone space on a first layer, such as Layer 0 in figure 1, is written with information, the complete available data zone on a second layer, such as Layer 1 in figure 1, needs to be filled with dummy data in order to make the recordable disc DVD-ROM compliant. This will take the maximum amount of time.

It is an object of the present invention to provide a method of arranging the information on a dual layer record carrier such that the amount of time required for making

the record carrier compatible with existing playback devices, especially with DVD-ROM players, will be reduced to a minimum, without prior knowledge of the amount of information that should be stored.

This object is achieved by providing a method in which a specific filling pattern is used for physically storing the data on a disc. By using this specific filling pattern the amount of time needed to close/finalize the session or disc is significantly reduced.

The DVD-ROM format specification describes that an area identified as middle zone does not necessary have to be filled with data. When the middle zone is located at a position prior to its maximum position, less space has to be filled with dummy data, as is shown in figure 2.

When the amount of information to be written is known on forehand, the location of the middle zone can be decided prior to writing. However, when this is not the case, the special filling pattern according to this invention can be used to achieve an optimal balance between available user space and required closure time.

Data to be recorded on a record carrier normally consists of several files. The logical location of each of these files is stored in file system tables. Since a DVD record carrier acts like a random access memory, the location of the files stored on the record carrier is not dependent on the order of these files in the file system. By balancing the amount of information to be written over all layers using the special filling pattern according to the invention, each of the layers will be filled at approximately the same rate.

An embodiment of the method according to the invention is described below with reference to figure 3 in which the various record carrier states are shown during the various steps of the method, and in which the special filling pattern is represented by a sequence of paths:

Step one (figure 3A):

- Starting from an empty dual layer record carrier;
- During recording the record carrier is treated as an open session, so the file system (FS) will not be written until the session is closed;
- The middle zone location is placed imaginary at the maximum location, thus providing the maximum amount of storage space.

Step two (figure 3B):

- The files (1, 2 and 3) are written on the record carrier;
- These files are written sequentially (path a);

- Although the files in figure 3 have identical sizes, the actually written files may vary in size.

Step three (figure 3C):

- When a predefined amount of storage space is filled, writing of subsequent files will stop on Layer 0 and will continue on Layer 1 (path b); it is noted that this predefined amount of storage space is the maximum amount of space (worst-case situation) that should be padded (that is, written with dummy data) when closing a session and/or finalizing a disc; for a recordable DVD disc where a single layer may hold up to 4.7 Gbyte of data, the size of the predefined amount of storage space should preferably be in the range of 50Mbyte to 500 Mbyte (that is, at least significantly less than the total amount of storage space available on one layer);
- The next files (4, 5, 6 and 7) will be written sequentially (path c) on Layer 1;
- Since the dual layer record carrier in this example is of an OTP type, the direction of writing on Layer 0 (path a) is reverse to the direction of writing on Layer 1 (path c).

Step four (figure 3D):

- When the sequential user data space on Layer 1 is filled, or the next file to be written (8) does not fit in the remaining space, writing continues on Layer 0 again (path d);
- The next files (8, 9, 10 and 11) are written sequentially on Layer 0 (path e) until a predefined location is reached.

Step five (figure 3E):

-The writing process will continue on Layer 1 (path f);
- The next files (12, 13, 14 and 15) are sequentially located on Layer 1 (path g).

Step 6 (figure 3F):

- When the current writing operation is finished, future files (16) can be located at the next available user space (path h).

In an embodiment of the method according to the invention an alternative special filling pattern is used for recording information on a record carrier using a PTP (Parallel Track Path) addressing mode. In such a record carrier using a PTP addressing mode each layer has the addresses ranging from the inner diameter of the disc to the outer diameter. Both layers have their own lead-in and lead-out areas. There is no middle zone present. Figure 4 shows a DVD disc using the PTP addressing mode, which is recorded according to this embodiment. This embodiment comprises the steps of (figure 4):

- Reserving the file system space (FS) when the writing starts;

- Writing the information until a predefined position is reached. The files (1, 2 and 3) are written sequentially (path a);
- Writing the next files (4, 5, 6 and 7) sequentially on the other layer (path c) after a first layer jump (b);
- When the predefined position on the other layer is reached, writing continues at the other layer (e) after a second layer jump (d).

The method according to the invention is not only suitable for use with dual layer record carriers, but also for use multi layer record carriers comprising more than 2 layers. Such multi later record carriers may use any of the OTP and PTP addressing modes. The special filling patterns for these multi layer discs correspond to ones described above for dual layer discs. Figures 5 shows embodiments of the method according to the invention for use with multi layer record carriers consisting of 'n' layers with either the OTP (figure 5A) or the PTP (figure 5B) addressing mode.

For a multi layer OTP type record carrier (figure 5A) it is assumed that the address ranges for each layer is opposite in direction with respect to the previous layer. Now, filling takes place from the lowest layer (Layer 0) up until the last layer (Layer n) in a block form as shown in figure 5A using the special filling pattern:

a→b→c...d...s→t→u→v→e→f→g...h...w→x→y→ etc.

When the topmost layer (Layer n) is reached, the next block will be written on the lowest layer (Layer 0) after a jump (v, respectively, z).

For a multi layer PTP type record carrier (figure 5B) it is assumed that the address ranges for each layer is in the same direction as the previous layer. Now, filling takes place from the lowest layer (Layer 0) up until the last layer (Layer n) in a saw-pattern like form as shown in figure 5B using the special filling pattern:

a→b→c...d...s→t→u→v→e→f→g...h...w→x→y→ etc.

Again, when the topmost layer (Layer n) is reached, the next file will be written on the lowest layer (Layer 0) after the jump (v, respectively, z).

By using the filling patterns according to the invention it is possible to exploit the maximum available user space to the fullest, while minimizing the amount of time required to close/finalize the disc or session. When a recordable DVD disc is written using the filling patterns according to the invention, the disc is fully compatible with the existing DVD-ROM standard and can be read by any standard DVD player, including DVD-ROM players.

Figure 6 shows a table comparing the best-case and the worst-case situations of the closing/finalizing time using either the filling pattern strategy according to the invention or a conventional sequential filling. In the best-case situation no closing/finalizing time is required in both situation: for sequential filling the complete data area is used and no extra filling time is needed for padding (that is, writing the dummy data); for special filling patterns according to the invention the session/disc will be closed/finalized after writing sequence g and again no padding needs to be done.

However, in the worst-case situation a significant reduction of the time required for closing/finalizing is obtained when the method according to the invention is uses. For conventional sequential filling the closing/finalizing time equals the time needed for recording a complete layer. When half of the available capacity is used (that is, only one layer is recorded), the other half of the capacity (on the other layer) needs to be padded (that is, written with dummy data). Now, for the special filling patterns according to the invention, the closing/finalizing time only equals the time needed for recording the pre-defined area. On Layer 1 an area with the size of the pre-defined recording area, which is significantly less than the total recording area on Layer 1, should be padded in order for the disc to be DVD-ROM compliant. For a recordable DVD disc where a single layer may hold up to 4.7 Gbyte of data, the size of the pre-defined recording area should preferably be in the range of 50Mbyte to 500 Mbyte (that is, at least significantly less than the total amount of storage space available on a single layer).

CLAIMS:

1. A method of recording information on a multi layer record carrier, said record carrier comprising at least two information layers for storing the information, wherein the information is distributed over the at least two layers according to a pattern such that the amount of information stored on the layers differs between the layers by less than a predefined amount.

2. Method according to claim 1, wherein areas holding recorded information on the at least two layers are superjacent.

3. Method according to claim 1, wherein the predefined amount is significantly less than the total amount of storage space available on one of the at least two information layers.

ABSTRACT:

This invention relates to a method for recording information on a multi layer record carrier. The information is recorded on the record carrier according to special filling patterns, such that the record carrier is compatible with the DVD-ROM standard and that the time required for closing a session and/or finalizing the disc is reduced.

Figure 5

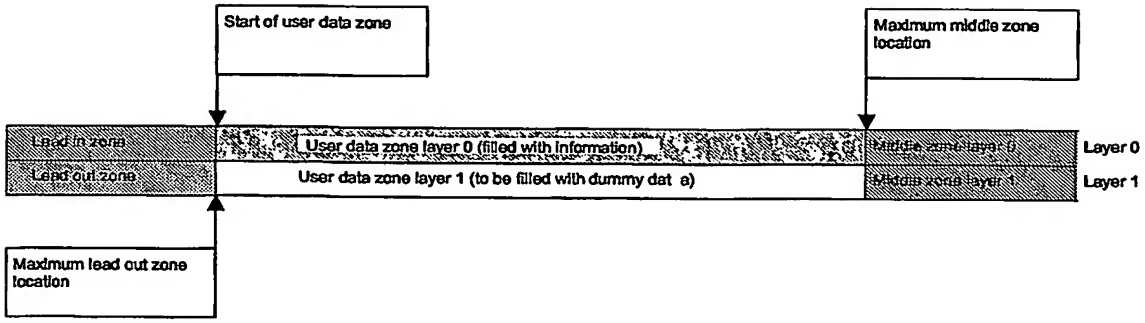

Start of user data zone
Maximum middle zone location
Lead in zone
User data zone layer 0 (filled with information)
Middle zone layer 0
Layer 0
Lead out zone
User data zone layer 1 (to be filled with dummy dat a)
Middle zone layer 1
Layer 1
Maximum lead out zone location

FIG. 1

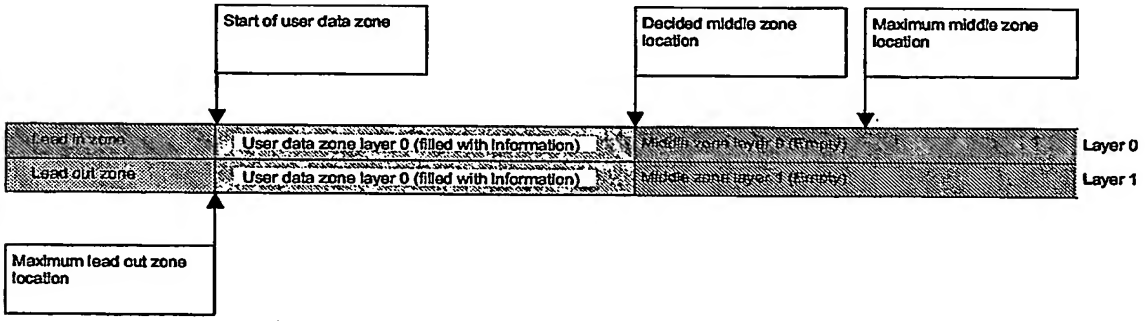

Start of user data zone
Decided middle zone location
Maximum middle zone location
Lead in zone
User data zone layer 0 (filled with information)
Middle zone layer 0 (Empty)
Layer 0
Lead out zone
User data zone layer 0 (filled with information)
Middle zone layer 1 (Empty)
Layer 1
Maximum lead out zone location

FIG. 2

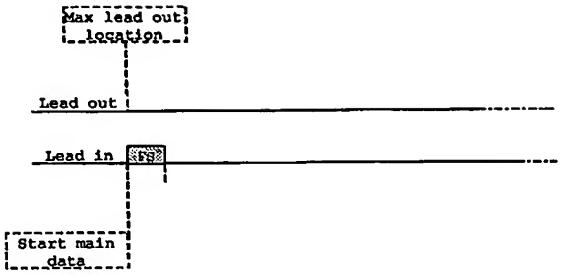


FIG. 3A

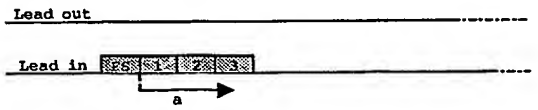


FIG. 3B

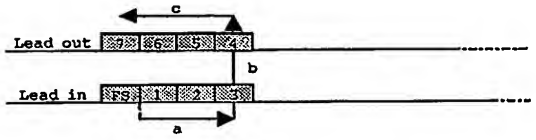


FIG. 3C

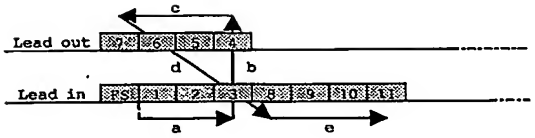


FIG. 3D

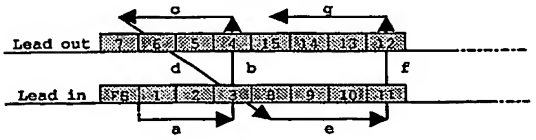


FIG. 3E

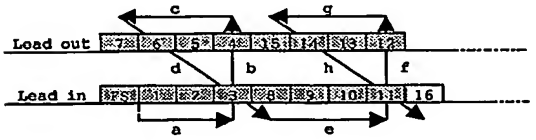


FIG. 3F

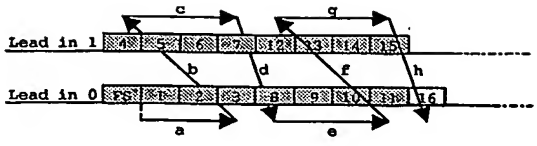


FIG. 4

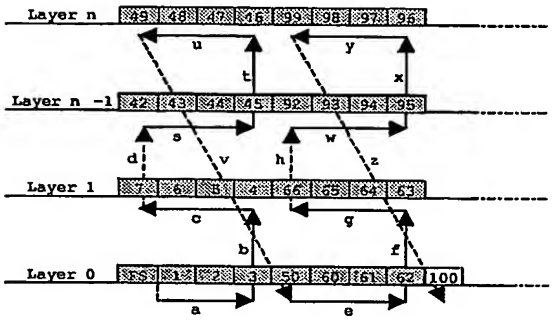


FIG. 5A

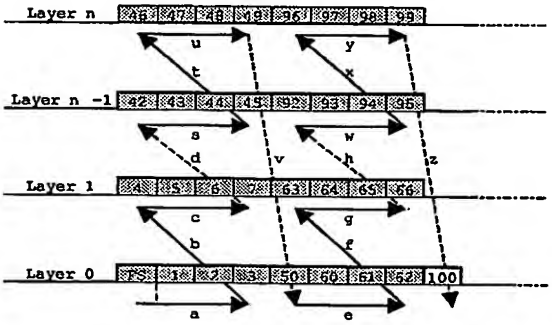


FIG. 5B

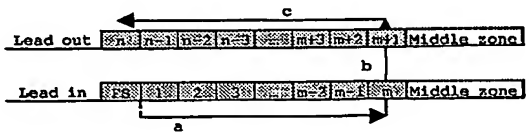
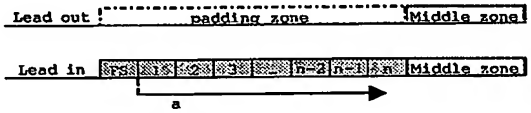
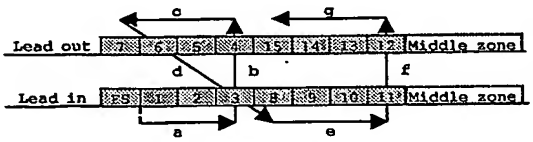
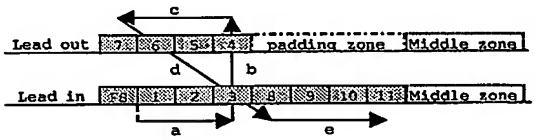
	Best case	Worst case
Sequential filling (prior art)		
Filling pattern (invention)		

FIG. 6